Amendments to the Specification:

Please replace the Title with the following amended title.

A VARIABLE FREQUENCY POWER SYSTEM AND METHOD OF USE

Please replace the paragraph 1 with the following amended paragraph.

The present invention generally relates to providing variable electrical power to a three phase electrical motor. More specifically, the present invention relates to varying electrical power to a three phase electrical motor based on varying frequency input turning an electrical generator which provides electrical power to the motor, in order to overcome variable conditions encountered by the motor that require a variation in electrical power to the motor.

Please replace the paragraph 4 with the following amended paragraph.

When it is desired to operate a three phase motor at a variable speed the current method is to input the constant frequency three phase power from a generator to a three phase variable speed drive. Sometimes the variable speed drive is referred to as a variable frequency drive. The variable speed drive supplies three phase power at a variable frequency to the three phase motor. The variable speed drive allows the three phase motor to be operated at a variable speed in direct proportion to the variable frequency of the power supply from the variable speed drive. Sometimes a transformer is required between the variable speed drive and the three phase motor to provide a voltage match required by the three phase motor. Fig. 1 shows an example of currently used systems for generating three phase variable frequency power to a three phase motor. The system includes an engine, three phase electrical generator, excitation controller, variable speed drive, transformer, switchboard, motor controller and the motor. The engine speed is controlled by a governor to maintain constant engine speed under varying load conditions imposed by the generator load and a fifty or sixty Hertz output requirement. The engine is usually mechanically coupled to the electrical generator, but other connections are also

used. The generator voltage output is controlled by the excitation controller. The output voltage of the generator is electrically connected by cables to the variable speed drive. The output of the variable speed drive is electrically connected by cables to the transformer. The transformer is normally of a multi-tap configuration to provide the appropriate voltage required by the motor. The multi-tap allows for numerous motor combinations to be used, which also makes it easier to accommodate the cable voltage loss associated with the wide range of cable sizes and lengths required to reach electric submersible pumps installed deep in oil & gas wells. A switchboard used as a power disconnect is connected along the cables between the transformer and the motor. A motor controller is an electronic unit used to control the frequency output of the variable speed drive as required by the motor based on feedback of varying conditions encountered by the motor. The motor controller also controls the on-off function of the switchboard. The motor controller is connected by cables to the switchboard, and by cables to the variable speed drive to monitor, control, and adjust the power to the motor by numerous programmed parameters.

Please replace the paragraph 7 with the following amended paragraph.

A variable frequency power system with a power source having a rotating output and a speed control to regulate rotational speed of the rotating output. A generator coupled to and driven by the rotating output of the power source, whereby the speed control of the power source directly controls output power frequency of the generator due to control of rotational frequency of the rotating output. A voltage regulator connected between the generator and the motor to regulate~~s~~ output voltage from the generator to the electrical motor load. A system controller controls output power frequency of the generator. The system controller interfaces with the speed control of the power source and is configured to monitor generator output and operational conditions of the electrical motor load. The system controller adjusts the speed control based on generator output and operational conditions of the electrical motor load.

Please replace the paragraph 11 with the following amended paragraph.

The present invention is a variable frequency power system to drive a three phase electrical motor at the frequency, voltage and amperage, as required by the motor operation to drive a driven unit. The variable frequency power system of the present invention can be especially applied where the driven unit is an electric submersible pump used in the oil and gas industry. The electric submersible pump is driven by an alternating current (AC) three phase electrical motor which exhibits a non-linear relationship between rotational speed and torque load due to the inherent characteristics of centrifugal pumping systems. The variable frequency power system includes a generator driven by a power source. The variable frequency power system includes a specially programmed logic circuit in a system controller, which interfaces with the power source of the generator. The programmed logic circuit is designed to monitor and control the driven unit by monitoring the conditions of the driven unit and controlling the supplied power to the motor. The variable frequency power system can be programmed with startup, steady-state operation, and emergency shutdown parameters for the driven unit. The driven unit is controlled by varying the voltage and frequency of the input AC power to the motor. The system controller would be responsible for adjusting and monitoring the generator output, and would adjust the generator to any voltage and frequency required by the driven unit within the effective operational limits of the generator. Not only can this equipment allow for desired steady-state operational parameters, it can be set up to allow for completely different parameters during start-up of high power draw electrical devices, such as electric motors, or to react to monitored inputs of the driven unit. The system controller of the variable frequency power system controls the generator speed, ~~and~~ output voltage~~, it~~ and is capable of accepting inputs from external sources to control the operation of the entire system. In the case of electric submersible pumps, current draw and pump operating pressures can be monitored and generator frequency and voltage can be automatically adjusted due to changes in those readings, including emergency shutdown of the pump, if needed. The variable frequency power system can also include a human-machine interface. The human-machine interface can include a display screen and input buttons to allow an operator the ability to select desired operational and startup routines, monitor operating system parameters, or to modify operational parameters as needed without requiring in-depth knowledge of the underlying hardware and code of the system controller.

Please replace the paragraph 15 with the following amended paragraph.

The engine ~~turns~~ rotates the three phase electrical generator designed for variable frequency operation. The generator is electrically coupled to the three phase motor. The throttle device is usually a combination of a throttle and electronic speed controller to control the speed of the engine, and thus control the turning frequency of the engine. Whereby, an increase or decrease in engine speed would in turn increase or decrease the frequency of generated three phase power being supplied to the three phase motor by the generator. The excitation controller is a voltage regulator capable of varying its voltage output in a programmable manner to the engine speed driving the generator. The system controller interfaces with the throttle device and the excitation controller to monitor, control and regulate the desired operating parameters of the electric motor. The system controller adjusts the speed based on monitored readings and the desired operating conditions of the motor for any one particular drive unit application. The monitored readings can be from sensors at the motor or in the case of an electric submersible pump, at the pump itself. The uninterruptible power supply keeps the monitoring, control and adjustment functions operating during large changes in the frequency of the electrical power being generated to power the motor.

Please replace the paragraph 17 with the following amended paragraph.

Since the output voltage of the variable frequency power system is monitored and controlled by the system controller, it is possible to adjust the output voltage of the generator independently of the output frequency. This flexibility allows the variable frequency power system to vary output voltage linearly with respect to frequency, or to maintain a fixed output voltage as frequency is varied depending on what is required by the load of the drive unit, a feature which is very useful during the initial starting of an electric submersible pump motor. The variable frequency power system allows the starting of high-load electrical equipment by controlling certain aspects of the engine-generator combination that was previously not possible to do accurately and consistently. The system controller of the variable frequency power system can control a startup sequence to start the engine-generator combination and run it at idle with no

load for a specified warm-up period. Once warm-up is achieved, the system controller can begin a startup sequence by bringing the engine to a starting frequency, for example fifteen Hertz, and then give the engine the command to go to full throttle. As the engine ramps up in speed and reaches roughly half the final operating speed, the system controller engages the power to the motor of the drive unit. The final operating speed for many applications is expected to be in the 45 hertz to 60 hertz range. This start sequence eliminates the mechanical reaction time inherent to the existing engine-generator combination when a sharp electrical load is introduced. Another start up method that can be realized with the variable frequency power system is for devices with high startup power draws, by using a reduced startup voltage method. The system controller can control a startup sequence to start the engine-generator combination and run it at idle with no load for a specified warm-up period. Once warm-up is achieved, the variable frequency power system brings the engine to a steady operating frequency slightly below full operating frequency, for example approximately around eighty-five percent of full operating frequencies. Once up to speed, the variable frequency power system sets the excitation controller to a reduced output voltage in a range of fifty to ninety percent of the rated voltage to ~~hertz~~ frequency ratio. At this point the system controller engages the power to the electrical motor of the driven device, holding the output voltage fixed at the preset reduced voltage regardless of engine speed change. After a given period of time elapses, the system controller instructs the excitation controller to ramp up the voltage to achieve the required volts to hertz ratio to be delivered to the motor based on the driven device. The system controller then waits until the system reaches steady operation at these settings before bringing the system to the final operational speed. This second start-up sequence takes advantage of the fact that the inertia of the engine and generator is sufficient such that the engine speed will be reduced while it picks up the additional load, but before the engine reaches a stall speed, it will recover and return to the required setting of the ~~Hertz~~ frequency selected for the power to be generated and delivered to the motor.

Please replace the paragraph 18 with the following amended paragraph.

The variable frequency power system allows for start-up modes to be designed to take advantage of the fact that at low speeds of about thirty Hertz, or about one-half of ~~it's~~ its full speed,[,] a diesel engine, or other similar engine driver, can produce up to fifty percent of its full load horsepower and up to sixty percent of its full load torque, while the electrical motor at this speed driving a centrifugal pump, only requires twenty-five percent of the horsepower of the engine. For the diesel engine to do this, the engine has to be at full throttle, so that the turbocharger is spooled up and giving the engine the required boost in power.

Please replace the paragraph 19 with the following amended paragraph.

It is therefore envisioned that start-up needs can be configured as follows. Run the engine at no load for warm-up. Set the system controller for running the motor at desired speed or current limit desired. An immediate or slow ramp can be accommodated. When the system controller gives signal to start the motor, then engine needs to slow down to idle speed of about fifteen Hertz, and then receives the signal to go to the set speed, and while the engine is under full throttle and gaining speed, ~~then~~ there after the switchboard engages the motor. About thirty Hertz would be a good point for engaging the motor. The engine will slow down slightly while picking up the motor load and then will continue on to its set speed or current setting for the motor.